PCBs IN THE UNITED STATES INDUSTRIAL USE AND ENVIRONMENTAL DISTRIBUTION

TASK I

FEBRUARY 25, 1976

FINAL REPORT

U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF TOXIC SUBSTANCES
WASHINGTON, D.C. 20460

EPA 560/6-76-005

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Task I

EPA Contract No. 68-01-3259

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For

Environmental Protection Agency

Office of Toxic Substances
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Washington, D. C. 20460

February 25, 1976

SECTION VII

PRODUCTION AND DISTRIBUTION

1.0 PRODUCTION AND CURRENT USE

1.1 Domestic Production of PCBs and PCTs

Currently there is only one known commercial scale PCB production installation in the U.S., the William G. Krummrich plant of the Monsanto Chemical Company in Sauget, Illinois. This facility is specifically designed for chlorobiphenyls production and has a design capacity of 48 million pounds per year.

Until 1971 PCBs were also manufactured at Monsanto's Anniston, Alabama plant which had a design capacity approximately equal to the Sauget plant. The Alabama operation was discontinued and the plant dismantled in 1971.

PCBs manufactured by Monsanto are marketed under trade name "Aroclor". Tables 1.1-1 and 1.1-2 present data from Monsanto related to production and sales of PCBs from 1957-1974 and production of polychlorinated terphenyls (PCTs) from 1959-1972. The production of PCTs were terminated in 1972. Until then in addition to PCBs (Aroclor series 12) Monsanto manufactured Aroclors 2565, 4465, 5442 and 5460. Aroclors 2565 and 4465 were blends of PCBs and PCTs and Aroclors 5442 and 5460 were two different grades of PCTs. Also given in these Tables are breakdowns of domestic sales per use category and by PCB grade. Detailed information and breakdown on PCB/PCT blends and PCT grades is not available. However, Monsanto reports that the predominant material produced was Aroclor 5460. When produced and marketed these materials were used in plasticizer applications. Figures 1.1-1 through 1.1-3 are graphical representations of these data.

As can be seen from Figure 1.1-1, the majority of the PCBs produced in the United States was marketed domestically. Production and sales of PCBs in 1974 were less than half of those for 1970, where production and sales of PCBs were at their maximum. The difference between production and sales on

TABLE 1.1-1

PCB & PCT MANUFACTURE AND PCB SALES

MONSANTO INDUSTRIAL CHEMICALS COMPANY

1957 thru 1964
(Thousands of Pounds)

	1957	1958	1959	1960	1961	1962	1963	1964
U.S. PRODUCTION OF PCBs	(1)	(1)	(1)	37919	36515	38353	44734	50833
DOMESTIC SALES OF PCBs	32299	26061	31310	35214	37538	38043	38132	44869
U.S. EXPORT SALES OF PCBs	(2)	(2)	(2)	(2)	(2)	(2)	3647	4096
U.S. PRODUCTION OF PCTs	-	-	2996	3850	2322	4468	4920	5288
DOMESTIC SALES OF PCBs BY CATEGORY								
Heat Transfer	-	-	-	-	-	157	582	929
Hydraulics/Lubricants	1612	1549	2685	2523	4110	3915	3945	4374
Misc. Industrial	704	755	1569	1559	2114	1681	1528	1692
Transformer	12955	5719	5984	7921	6281	7984	7290	7997
Capacitor	17028	14099	16499	16967	15935	15382	15606	19540
Plasticizer Applications	(1)	3939	4573	6244	9098	8924	9181	10337
Petroleum Additives	-	-	-	-	-	-	-	-
DOMESTIC SALES BY PCB GRADE								
Aroclor 1221	23	16	254	103	94	140	361	596
Aroclor 1232	196	113	240	155	241	224	13	13
Aroclor 1242	18222	10444	13598	18196	19827	20654	18510	23571
Aroclor 1248	1779	2559	3384	2827	4023	3463	5013	5238
Aroclor 1254	4461	6691	6754	6088	6294	6325	5911	6280
Aroclor 1260	7587	5982	6619	7330	6540	6595	7626	8535
Aroclor 1262	31	184	359	326	361	432	414	446
Aroclor 1268	-	72	102	189	158	210	284	190
Aroclor 1016	-	-	-	-	-	-	-	-

(1) Production figures and Plasticizer Applications figures unavailable during year indicated.
(2) U.S. Export Sales figures unavailable during year indicated.

TABLE 1.1-2

PCB & PCT MANUFACTURE AND PCB SALES

MONSANTO INDUSTRIAL CHEMICALS COMPANY

1965 thru 1974
(Thousands of Pounds)

	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
U.S. PRODUCTION OF PCBs	60480	65849	75309	82854	76389	85054	34994	38600	42178	40466
DOMESTIC SALES OF PCBs	51796	59078	62466	65116	67194	73061	34301	26408	37742	34406
U.S. EXPORT SALES OF PCBs	4234	6852	8124	11231	10624	13651	-	6388	8346	5395
U.S. PRODUCTION OF PCTs	6470	8190	9450	8870	11600	17768	20212	8134	-	-
DOMESTIC SALES OF PCBs BY CATEGORY										
Heat Transfer	1237	1766	2262	2529	3050	3958	3060	752		
Hydraulics/Lubricants	4616	4258	4643	5765	8039	7403	1552	0		
Misc. Industrial	1841	1779	1426	1283	1079	1627	1155	0		
Transformer	8657	8910	11071	11585	12105	13828	11134	25656	37742	34406
Capacitor	23749	28884	29703	29550	25022	26708	14141			
Plasticizer Applications	11696	13481	13361	14404	16460	19537	3259	0		
Petroleum Additives	-	-	-	-	1439	-	-	0		
DOMESTIC SALES BY PCB GRADE										
Aroclor 1221	369	528	442	136	507	1476	2215	171	35	57
Aroclor 1232	7	16	25	90	273	260	171	0	0	0
Aroclor 1242	31533	39557	43055	44853	45491	48588	21981	728	6200	6207
Aroclor 1248	5565	5015	4704	4894	5650	4073	213	807	0	0
Aroclor 1254	7737	7035	6696	8891	9822	12421	4661	3495	7976	6185
Aroclor 1260	5831	5875	6417	5252	4439	4890	1725	305	0	0
Aroclor 1262	558	768	840	720	712	1023	1	0	0	0
Aroclor 1268	196	284	287	280	300	330	0	0	0	0
Aroclor 1016	0	0	0	0	0	0	3334	20902	23531	21955

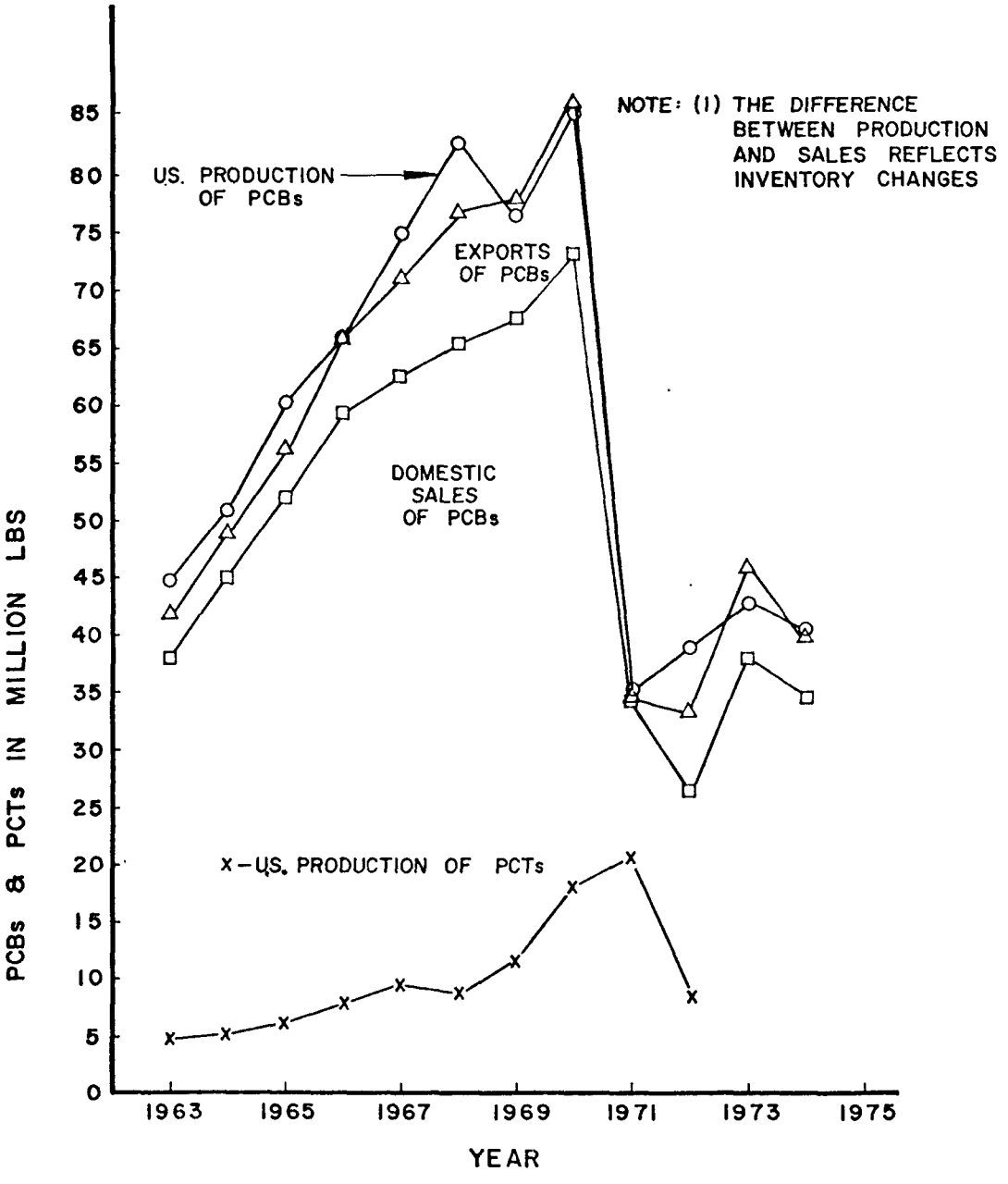


Figure 1.1-1 - U.S. Production of PCBs and PCTs and Domestic Sales and Exports of PCBs

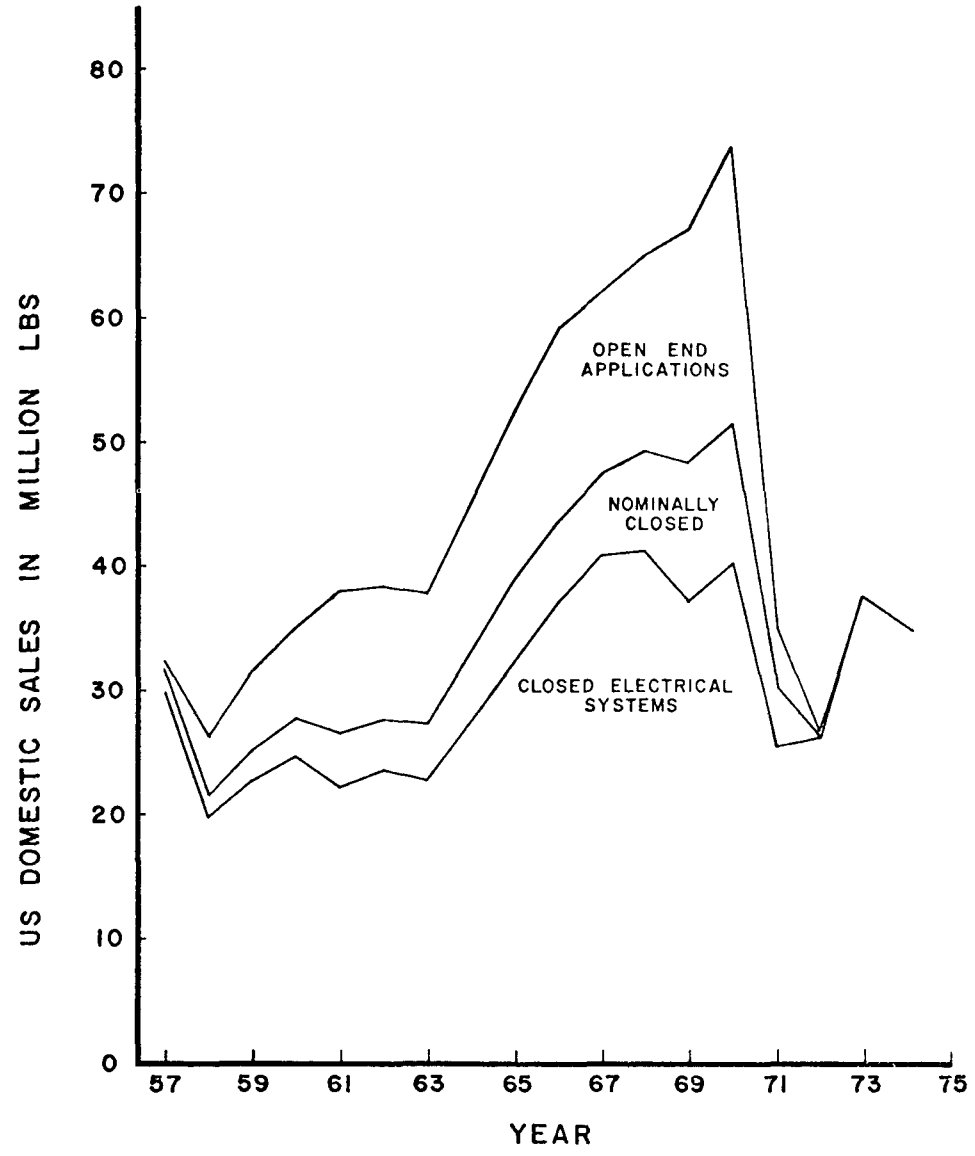


Figure 1.1-2 - U.S. Domestic Sales of PCBs by End Use Applications

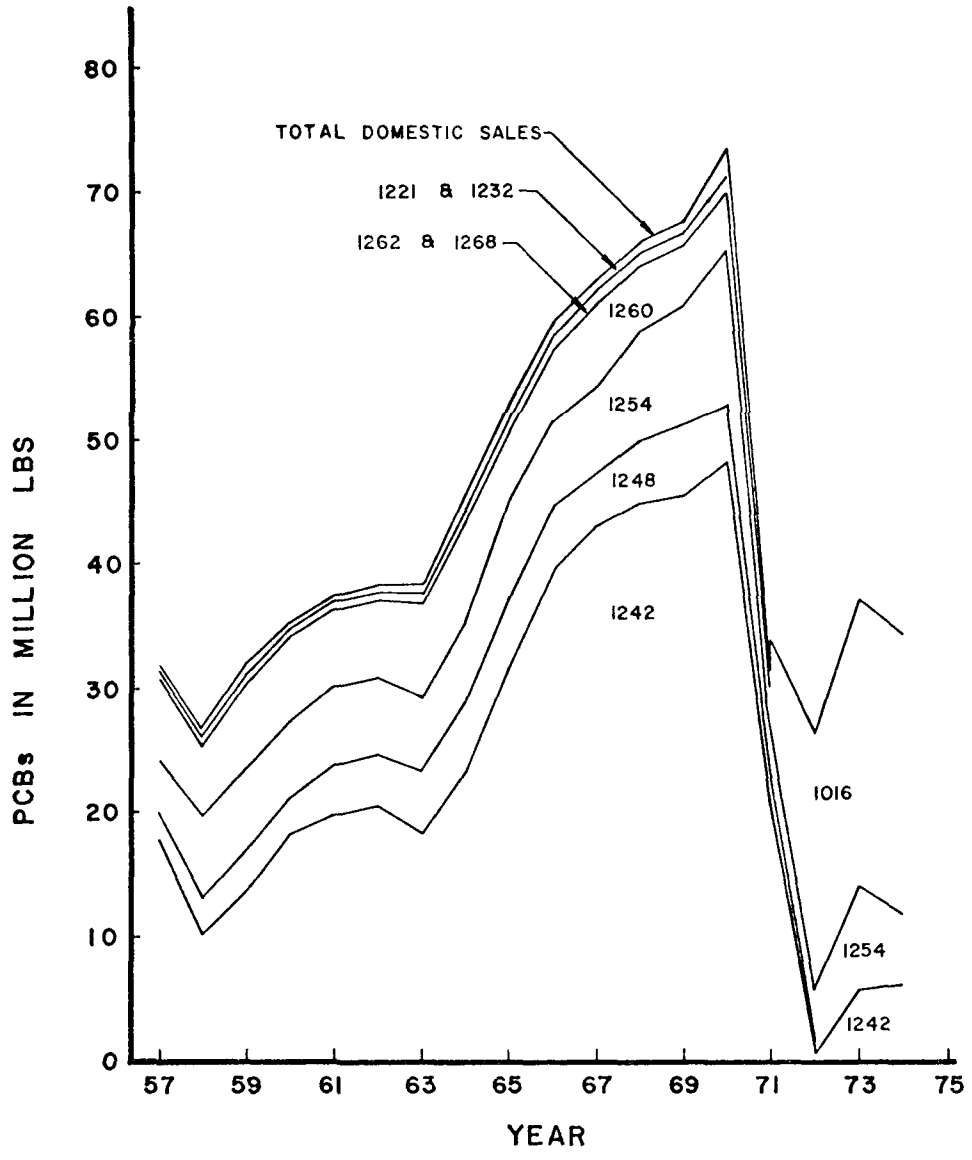


Figure 1.1-3 - U.S. Domestic Sales of PCBs by Type

this graph reflects inventory changes of PCBs. Figure 1.1-1 also indicates that the production of PCTs increased steadily through 1971 when their production was at the maximum. The production of PCTs was terminated in 1972.

Table 1.1-3 shows production, sales and export of PCBs for the first quarter of 1975. Monsanto reports that sales for Aroclor are expected to increase at an average annual rate of 6-7 percent over the next few years. Additionally, exports of Aroclor are expected to maintain the same ratio to the U.S. production as in the past.

Figure 1.1-2 indicates that prior to Monsanto's voluntary restriction of sales to all applications with the exception of "closed electric systems", approximately 13 percent of the PCBs in the U.S. was used in "nominally closed" applications (heat transfer, hydraulic fluids and lubricants) and 26 percent was used in "Open End" applications (plasticizers, surface coating, ink, adhesives, pesticide extenders, and microencapsulation of dyes for carbonless duplicating paper) where entries of PCBs to the environment are more probable and PCB emissions are uncontrollable. At present, almost all domestic production is being used in "closed electric systems" (transformer and capacitor applications) where PCB emissions are more controllable.

Between 1957 and 1971 there were twelve different types of Aroclor manufactured by Monsanto with chlorine contents ranging from 21 to 68 percent. Aroclor 1242 and grades lower than 42 percent chlorine made about 48 percent of the total production consumed. U.S. Sale of Aroclor 1242 has dropped drastically since 1971 and has been replaced by Aroclor 1016. Sales of Aroclor 1254 remained about the same for the period 1957 - 1974. Currently, there are four different types of Aroclor manufactured by the Monsanto Company-Aroclors 1221 and 1016 for capacitor applications and Aroclors 1242 and 1254 for transformer applications.

Past and current end-use of PCBs by types are presented in Table 1.1-4. In the years prior to 1971 the largest "open-end" use of PCBs and PCTs has been in plasticizer applications. According to Monsanto, a large percentage of the production of Aroclor 1242 and lower chlorine content grades and the entire PCT production were used for this application. Following Monsanto's

TABLE 1.1-3

PCB MANUFACTURE AND SALES

MONSANTO INDUSTRIAL CHEMICALS COMPANY

First Quarter - 1975

	(Thousands of Pounds)
U.S. PRODUCTION	8532
DOMESTIC SALES	7986
U.S. EXPORT SALES	1538
DOMESTIC SALES	
Transformer and Capacitor	7986
DOMESTIC SALES BY PCB GRADE	
Aroclor 1221	10
Aroclor 1242	2201
Aroclor 1254	2115
Aroclor 1016	3660
PREDOMINANT UTILIZATION OF AROCLORS	
Aroclor 1221, Aroclor 1016	Capacitors
Aroclor 1242, Aroclor 1254	Transformers

TABLE 1.1-4

END-USES OF PCTs AND PCBs BY TYPE

End-Use	1016	1221	1232	1242	1248	1254	1260	1262	1268	PCTs
Existing Sales										
Capacitors	XX	X		XX through 1971		X				
Transformers				X		XX	X through 1971			
Sales Phased-Out										
Heat transfer				X						
Hydraulics/ lubricants										
. hydraulic fluids			X	X	X	X	X			
. vacuum pumps					X	X				
. gas-transmission turbines		X		X						
Plasticizers										
. rubbers		X	X	XX	X	X			X	
. synthetic resins					X	X	X	X	X	XX
. carbonless paper				XX						
Miscellaneous Industrial										
. adhesives		X	X	XX	X	X				XX
. wax extenders				XX		X			X	XX
. dedusting agents						X	X			
. inks						X				XX
. cutting oils						X				
. pesticide extenders						X				
. sealants & caulking compounds										XX

Notes: (1) X denotes use of a given Aroclor in a specific end-use, while XX denotes principal use
(2) PCTs denote series 25,44 & 54 Aroclors

Source: Monsanto Industrial Chemical Co.

voluntary restrictions in 1972, Aroclor sales for plasticizer applications dropped to small percentage to that of the previous years. Historically, capacitors have always been the single largest PCB use category except for the years 1969-1971 when Aroclor usage for plasticizer applications was higher. The major uses of PCBs prior to 1969 in order of volume of material used is listed below:

- Capacitors
- Plasticizers
- Transformers
- Hydraulic fluids and lubricants
- Heat transfer fluids

1.2 Foreign Production and Distribution of PCBs

Known current foreign producers of PCBs are the United Kingdom, Czechoslovakia, France, Germany, Italy, Spain and the U.S.S.R. Detailed information on total production of PCBs outside the U.S. is not available. However, total foreign production of PCBs was roughly estimated by the Interdepartmental Task Force to be 80-85 million pounds annually prior to 1971. This value included 26 million pounds produced by Japan. Foreign production of PCBs has, however, decreased primarily due to Japanese action on banning the domestic production of PCBs. In 1973 foreign production of PCBs was estimated to be 43 million pounds, accounting for a 50% reduction. Production, trade and use of PCBs by OECD member countries for the year 1973 is given in Table 1.2-1. The combined PCB output of three major European producers, France, Italy and United Kingdom was about 36 million pounds in 1973. World commerce in PCBs is expected to decrease further, due to OECD member countries' activities, and to be essentially confined to capacitor and transformer applications.

1.3 Summary of Recent PCBs and PCTs Imports

A summary of estimated imports of PCBs since 1971 is presented in Table 1.3-1. Importation of PCBs appears to be steady or increasing, and currently is in the range of one percent of the domestic sales reported by Monsanto.

Table I.2-1 - Production, Trade and Use of PCBs
OECD Member Countries (1973)

Country	Total Production of PCBs	Total Import of PCBs	Total Export of PCBs	End of Use by Category								
				Transformer Application	Capacitors (large)	Capacitors (small)	Heat Transfer System	Hydraulic Equipment	Vacuum Pump	Lubricating & Cutting Oil	Plasticizers	Others
Australia												
Austria[2]	*											
Belgium	0	?	?	1.16	0.40	-	?	?	?	?	?	0
Canada	0	2.38	0	1.98[3]	0.44[4]	0.41[4]	0	0	0	0	?	0
Denmark												
Finland	0	0.53	0	0.09[3]	0.44[4]	0	0	0	0	?	0	0
France	21.33	0.66	10.12	6.48	2.87		0.16	0.17	0.01	0.49	1.45	0.25
Germany[2]	*											
Greece												
Iceland												
Ireland												
Italy	5.55	3.53	2.44	2.70	3.14[3,4]	0	0	0	0	0	0.64[4,5]	0.16[6,8]
Japan	0	(2)	(2)									
Luxembourg												
Netherlands	0	?	0	?	?	?	?	?	?	0	0	0
New Zealand	0	0.04[9]	0	0.075	0	0	0	0	0.005	0	0.02	0
Norway[10]	0	0.04	0	0	0.05[4]	0.005	0	0	0	0	0	0
Portugal												
Spain	*											
Sweden[10]	0	0.70	0	0	0.72	0	0	0	0	0	0	0
Switzerland												
Turkey	0	0	0									
United Kingdom	8.97	0.01	6.53	0.71[3]	← 1.82[9] →							
United States	42.18	0.57	8.35	← 37.87[13] →			?	0.04	?	?	0.04[12]	?

Notes:

(1) All quantities are in million pounds

(2) Information is not available

(3) PCB containing 54 wt % chlorine

(4) PCB containing 42 wt % chlorine

(5) PCB containing 64 wt % chlorine

(6) PCB containing 70 wt % chlorine

* indicates PCB producer country

(7) "Others" refers to PCBs were used to reseller and in research

(8) "Others" refers to PCBs used as a fire-retardant in plastics

(9) This figure includes about 6 percent from previously imported material

(10) Amount reported as import and quantities quoted in usage do not agree

(11) With regards to the use of PCBs in transformers and capacitors, definitive figures are not available

(12) Used in investment casting

(13) This figure includes 0.13 million pounds of imported material

Table 1.3-1

Preliminary Summary of PCBs Import Data for
1971-75 Versus Monsanto Production and Sales Data

	Year or Portion of Year				
	1971	1972	1973	1974	1975
Estimated Imports (lb)	550,000	700,000	480,000	450,000	450,000 (6 mos)
Monsanto Domestic Sales (lb)	34,301,000	26,408,000	37,742,000	34,406,000	7,986,000 (3 mos)
Imports as Percentage of Domestic Sales	1.6	2.7	1.3	1.3	-
Monsanto Exports (lb)	-	6,388,000	8,346,000	5,395,000	1,538,000 (3 mos)
Ratio of Exports to Imports	-	9.1	17.3	13.5	-

During 1971 and 1972 most of the PCBs imported into the United States originated in Japan, ostensibly corresponding to sales of stocks unsalable in Japan due to pending or established regulatory action. There apparently has been little or no U.S. importation of PCBs from Japan since 1972. The major importer was Marubeni America Corp., West Caldwell, N.J.

Since 1972, most of the imported PCBs originated in Italy, with a small amount imported from France (manufactured by Prodelec). This French material is similar to Aroclor 1242 and is used (40,000-60,000 lb. per year) as a coolant in mining machinery by Joy Mfg. Co., Franklin, Pa. Decachlorobiphenyl (Fenclor DK) is imported from Italy by Yates Mfg. Co., Chicago, Ill., for use in the manufacture of investment casting waxes. Estimated current usage is about 400,000 lb/year.

Polychlorotriphenyls, also used in pattern wax formulations, appear to be imported at an increasing rate. Estimated amounts are:

1973	1974	1975 (6 mos.)
160,000 lb.	330,000 lb.	200,000 lb.

Major importers of PCTs are Progil, Inc. (formerly Prochimie) and Intsel Co., both located in the New York City area. Most of the imported PCTs originate in France (Prodelec).

Use of PCBs and PCTs in casting waxes appears to be generally stable or increasing slowly, and under conditions of lack of regulatory control in the future, such use would be expected to continue at least at the current rate. On the other hand, Joy Mfg. Co. no longer manufactures mining equipment using PCBs as coolant; the amounts imported by Joy are used to service existing equipment. However, since Joy imports only 10 to 20 percent of the total, the overall imports will not be affected greatly by future decreases in imports by Joy.

2.0 FIFTEEN YEAR EXTRAPOLATIONS FOR PCB PRODUCTION AND USE IN ELECTRICAL EQUIPMENT

The subject data base was assembled from domestic sales figures for Aroclors reported by Monsanto – capacitor and transformer sales being summed

to obtain totals. For certain years (1972-1973), sales data were reported in aggregate, and in such cases, the reported figures were taken as totals, and usage breakdown was accomplished by assigning total amounts of Aroclor 1221 and 1016 to capacitors and total amounts of Aroclor 1242, 1248, 1254, and 1260 to transformers. All 1975 totals were obtained by quadrupling the reported first-quarter sales figures - a process which very likely yields an approximate lower-bound to the actual yearly totals - and, ultimately, Table 2-1 was constructed.

Manifestly, the available data base is far too limited to form the basis for any rational statistical analysis. The strong pertubational decrement in the 1971-1972 interval precludes the application of incremental regression -- even if a fifteen-year extrapolation were not required. In short, then, trend analysis becomes a generally risky proposition, and the optimum analytical approach seems to be limited to unbiased extrapolations of least-square linear fits to grouped subsets of the available data points.

Given this, three data base subsets appear promising:

(i.) the full base -- using all reported and 1975-estimated data, unweighted and unbiased;

(ii.) a singly-deleted base -- using all reported data, but eliminating the 1975 estimates. This tends to weight the extrapolations (however weakly) with regard to recent (last-decade) performance only, but the resulting curves can then be inspected without the bias of the estimated 1975 totals; and

(iii.) triply-deleted base -- formed by extracting the depressed 1971 and 1972 totals from the singly-deleted base. This construction eliminated the bias of the 1975 estimates, and discounts the effects of the interval decrements caused by regulatory effects. (A perhaps more realistic picture might be obtained by placing a decremental weight on 1975 totals -- under the assumption that some of the roll-back is reactively

Table 2-1

Total PCB Breakdown by Use
1966 - 1975

Year	Total (10^6 lbs.)	Capacitors (10^6 lbs.)	Transformers (10^6 lbs.)
1966	37.794	28.884	8.910
1967	40.774	29.703	11.071
1968	41.135	29.550	11.585
1969	37.127	25.022	12.105
1970	40.536	26.708	13.828
1971	25.275	14.141	11.134
1972	25.656	20.321	5.335
1973	37.742	23.566	14.176
1974	34.406	22.000	12.000
1975 (est.)	31.944	20.644	11.300

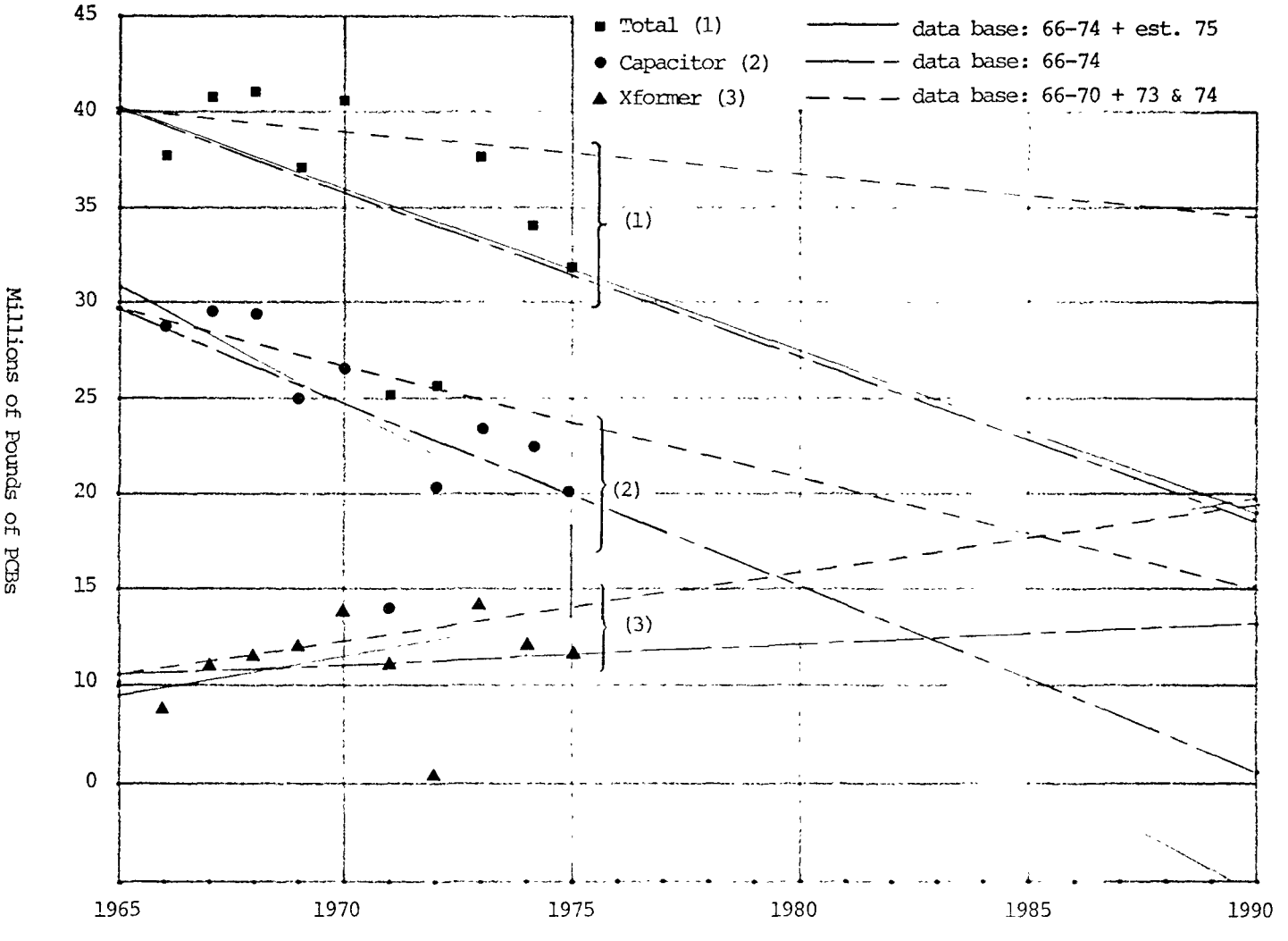
induced by the strong depression in the 1971-1972 totals. This would result, however, in externally biased extrapolations, and justifying a long-term lag of such effects with the available data appears difficult.)

These data bases, and the unbiased, least-square linear extrapolations derived from them, are graphed in Figure 2-1. Inspection of the curves shows that the 1975 estimate has little effect on the aggregate total; an event readily accounted for by noting that the singly-deleted base has the effect of depressing the capacitor total only slightly more than it elevates the transformer total. The triply-deleted base, however, provides almost no perturbation to the transformer total derived from the full base. Inspection of the curves for the aggregate total and the capacitor total indicate that this arises from the fact that the ratio of their time-derivatives (slopes) for the triply-deleted base is almost equal to its value with the full base.

Generally, the developed extrapolations disagree with mid-1975 industry estimates for the near-term future. Apparently, Monsanto and capacitor manufacturers tend to expect 1975 totals to resemble 1974 totals, followed by a five to ten percent increase in 1976, and a general four to five percent increase over the preceding year for 1977 on. Obviously, increases by a fixed percentage over preceding years yields exponentially increasing totals – an event undoubtedly strongly desired, but probably wholly utopian. Transformer manufacturers appear to tend toward a more conservative view; General Electric for example, expecting the demand for power transformers to rise and the demand for distribution transformers to fall – probably yielding a general saturation of the sales figures when integrated over all types.

Taking the available information into consideration, the impression remains that the triply-deleted data bases probably provide the most likely picture of what might be expected over a 25-year term. Naturally, such scenarios assume the external *status quo* as constant; technological, economic, and regulatory factors being capable of producing strong (and unassessable) variations in usage patterns. As a matter of fact, very recently, Monsanto has publicly announced that they would support a cessation of the PCB production when suitable alternative materials become available.

Figure 2-1. Unbiased Extrapolations of Least-Square Linear Curves for PCB Production and Use in Electrical Equipment



3.0 OVERALL MATERIAL BALANCE

Three separate approaches have been taken to obtaining overall data on total PCBs production, historical usage, and current distribution in the environment. Most of the uncertainty lies in the period 1930-1960, for which Monsanto data are lacking. Use of PCBs in transformers, particularly in electrical distribution systems, apparently began almost simultaneously with commercial production. Extensive use in capacitors can be traced to the intensive development and use of electrical home appliances, starting in the mid to late 1940's. Use in adhesives, paper, lubricants, etc., probably began in the early 1950's, and use of PCBs as a heat transfer fluid began early but increased rapidly between 1950 and 1970.

Using the Monsanto production data for 1960 to 1975, and assuming a linear increase in total PCBs production between 1930 and 1960, we obtain:

Production 1960 - 75	850×10^6 lb
Production 1930 - 60 (30 yr $\times$ 19 $\times$ 10^6 lb/yr ave)	570×10^6 lb
Total	$1{,}420 \times 10^6$ lb

Estimates of total PCBs usage by U.S. industries for the period 1930 - 1975 are given below:

PCBs by use category	
Capacitor & transformers	965×10^6 lb
Heat transfer	20×10^6 lb
Hydraulics/lubricants	80×10^6 lb
Misc. industrial	27×10^6 lb
Carbonless copying paper	45×10^6 lb
Other plasticizer uses	115×10^6 lb
Petroleum additives	1×10^6 lb
Total from Monsanto	$1{,}253 \times 10^6$ lb
Estimated total U.S. imports of PCBs	3×10^6 lb
Grant total PCBs usage	$1{,}256 \times 10^6$ lb

Alternatively, we have fitted least square correlations to each of the sets of Monsanto sales data for various uses, and to the domestic sales data set from 1957 to 1974, projected each plot back to 1930, and integrated. These operations, plus the addition of several other well established data points, produce the following results:

Total Domestic Sales, 1930 - 1970	767×10^6 lb
Domestic Sales, 1971 - 1975	168×10^6 lb
Total Exports, 1963 - 1974	82×10^6 lb
Estimated Exports, 1930 - 1963; 1975	70×10^6 lb
Monsanto In-House Use (unreported as sales)	25×10^6 lb
Total	$1{,}112 \times 10^6$ lb

As a comparison with the above, the 1973 Foster D. Snell study of PCBs concluded that the upper bound of U.S. usage of PCBs over 1934-72 was 1.175×10^9 lb. Adding usage figures for 1973-75 (about 105×10^6 lb), plus 150×10^6 estimated total exports, one obtains:

Estimated Total U.S. Production to Date	1.43×10^9 lb
Estimated Total U.S. Usage to Date	1.28×10^9 lb

Thus, it appears that the approaches taken to obtaining overall production and use quantities from various types of estimates yields:

U.S. Production

Maximum	1.4×10^9 lb
Minimum	1.1×10^9 lb

U.S. Usage

Maximum	1.25×10^9 lb
Minimum	1.0×10^9 lb

Sufficient data have been generated to allow an approach to the usage quantity through estimated quantities now in use or in the environment:

Transformers - 135,000 in service x 2,250 lb/unit average content	300×10^6 lb
Power Capacitors - 5×10^6 in service x 36 lb/unit average content	180×10^6 lb
Industrial Capacitors - 790×10^6 in service x 0.35 lb/unit average content	270×10^6 lb
Total in Electrical Service	750×10^6 lb
Total Other Than Electrical	8×10^6 lb
Grand Total	758×10^6 lb
Estimated "free" PCBs in the environment (see Section IX)	150×10^6 to 175×10^6 lb
Estimated amount degraded or incinerated (20×10^6 lb. by contract incineration; 5×10^6 lb incinerated with sewage sludge and other solid wastes; and 30×10^6 lb degraded mono and dichloro homologs) -	55×10^6 lb

Estimated amounts to landfill or dump:

Ten percent of capacitor and transformer usage as production wastes - $1.06 \times 10^9 \times 0.10 =$	110×10^6 lb
Obsolete electrical equipment (capacitors mainly) -	80×10^6 lb
Other sources (paper, plastics, etc.) -	100×10^6 lb
Estimated total	290×10^6 lb

In summary:

Amount in use	758×10^6 lb
Amount in landfills	290×10^6 lb
Amount "free" in soil, water, air, sediment	150×10^6 lb
Amount degraded or incinerated	55×10^6 lb
Total	$1,253 \times 10^6$ lb

Thus, using estimates, we can account for the maximum usage of 1.25×10^9 lb. calculated previously. We believe that the ranges of production and usage are well-defined by the maximum and minimum values presented above, and that the accuracy of the maximum values are sufficient for use in gross calculations pertaining to the PCBs problem.

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